Introduction

L.S. Schroeder

This report describes the activities of the Nuclear Science Division (NSD) for the period, January 1, 1997 to January 1, 1998. This was a period of outstanding accomplishments in our research activities, as discussed in the overviews and the contributions elsewhere in this report. Major transitions occurred with the successful move of Gammasphere to Argonne in the fall of 1997 for the second phase of its nuclear structure program, the successful completion and initial testing of the STAR time projection chamer (TPC) at the Lawrence Berkeley National Laboratory (LBNL) and its transport via aircraft to Brookhaven in early November 1997, and the completion of the major NSD contributions to the Sudbury Neutrino Observatory (SNO) detector. Challenges for the future with respect to these major pieces of nuclear physics instrumentation will involve the return of Gammasphere to the 88-Inch Cyclotron, expected for the period around fall 1999, and the transition to first physics results with the STAR detector at RHIC in the summer/fall period of 1999 and the initial physics results from SNO which are expected by the early part of 1999.

In addition to the major changes in the instrumentation area indicated above, along with their corresponding research thrusts, several significant adminstrative changes occurred during the last year. Janis Dairiki stepped down from her very successful roles as Division Deputy and Group Leader of the Isotopes Project. She was a major force within the NSD and through her dedication and attention to the activities of the NSD, helped us keep our focus and our excellence in the research arena. Gordon Wozniak has taken over the position of Division Deputy, with major new responsbilities in the area of environmental health and safety. Rick Norman has assumed the role of Isotopes Project Group Leader. At the 88-Inch Cyclotron, I-Yang Lee has assumed the role of Scientific Head of our Low-Energy Program. These new appointments bring substantial strength to these positions and provide the NSD with new leadership as we move into the 21st century.

During this last year at the 88-Inch Cyclotron we continued to work on adding new capabilities for the research community. The Berkeley Gas-Filled Separator (BGS) is nearing completion and will be operational in 1998 with a major new capability for heavy element research and nuclear structure studies. The 8π array arrived from Chalk River and is now installed and ready to begin its research program in the early spring of 1998. Activities continue in trapping radioactive ^{21}Na atoms. R&D on a light radioactive beam capability at the 88-Inch Cyclotron continued during the last year. Further testing is needed to determine the feasibility of coupling a local (Bldg. 56) medical accelerator to the 88-Inch Cyclotron

through a transfer line with injection into the local ECR and acceleration by the 88-Inch Cyclotron. Finally, solid progress continues to be made on a 3rd generation ECR ion source which will provide the heaviest beams at energies above the Coulomb barrier for the 88-Inch research community.

The Institute for Particle and Nuclear Astrophysics (INPA), a joint activity with the Physics Division, continues to look to the future of neutrino astrophysics and the potential for a next-generation detector km-scale system to study high energy neutrinos of astrophysical origin. R&D activities, across divisional lines, are being carried out and the possibilities of either an ice-based or water-based detector are being studied.

In the area of relativistic nuclear collisions, both the experiments at CERN (NA49) and the Brookhaven AGS (E895) are analyzing data. As an example, coupled with earlier data from the Bevalac, the energy-dependence of the flow of nuclear matter is one of the physics topics currently under study. In addition, the production of strangeness in central nucleus-nucleus collisions (for the heaviest nuclei – Au+Au at the AGS and Pb+Pb at CERN) also receives considerable attention. With the operation of the STAR detector at RHIC just a little over one year away, our research efforts are now focusing on physics with STAR. During the last year, James Symons has taken charge of leading this physics activity. Considerable effort, within the STAR collaboration, is being focussed on the computing challenges associated with the unprecedented amount of data which will come from the detector. Locally, with the existence of the NERSC (National Energy Research Scientific Computing) facility and its associated expertise, we intend to play a major role in STAR data analysis and associated simulations. Our Grand Challenge activities are also focussed in this area. As mentioned above the STAR TPC is now at RHIC where it will undergo further testing before insertion into the RHIC ring. In order to accomplish this, over the next year and beyond, members of the experimental Relativistic Nuclear Collisions (RNC) team will need to be in residence at RHIC. This process has already started.

The Nuclear Theory program has continued to be very active over the last year. A substantial visitory program was developed, with particular emphasis on providing contact with our experimental efforts with SNO, low-energy nuclear physics (particularly nuclear structure) and STAR physics. In conjunction with the Institute for Nuclear Theory at Seattle a very successful Winter Workshop on Hadronic Signals of New Physics at RHIC was held at LBNL last year. Also, a collaboration between our local theory and experimental groups resulted in the International Workshop on Soft Dilepton Production. This outstanding meeting had the unique feature of having all talks posted electronically (http://macdls.lbl.gov/dilepton.html). The close interaction of the theory effort with our experimental programs continues to enrich both sides.

The Isotopes Project continues to focus on electronic data dissemination especially in the areas of nuclear structure and nuclear astrophysics. Isotope Explorer 2.0, a PC Windows 32-bit C++ nuclear data helper application, jointly developed by LBNL and the University of Lund will

be released in early 1998. It will display nuclear data from the Evaluated Nuclear Structure Data File (ENSDF) as nuclear level scheme drawings, Nuclear Data Sheets-style tables complete with comments and footnotes, graphs of level properties and charts of the nuclides. Collaborative efforts with the NNDC (National Nuclear Data Center) at Brookhaven and other data centers continue and are being strengthened.

In the area of educational outreach, a major milestone has been achieved with the Nuclear Science Wall Chart. After several years of intense work, in collaboration with the U.S. nuclear science community, the final version of the Wall Chart is near completion and will be released in early 1998. The chart, originally conceived by members of the NSD, was developed with a national committee working under the auspices of the Contemporary Physics Education Project (CPEP). The chart is designed to convey both the fundamentals and the excitement of contemporary nuclear science to high school students and introductory college students. Topics include: radioactivity, nuclear energy, expansion of the universe, phases of nuclear matter, applications, chart of the nuclides and the newest element (112).

As indicated in last year's annual report (covering 1995 and 1996) we are no longer printing a hard copy of the annual, only the electronic version as published on the World Wide Web (WWW). I want to thank Rick Firestone, whose solid effort put this year's electronic version together. Also Anne Marie Piche was of great assistance in getting all the contributions for the report. Please address any comments or suggestions to this year's editor, Rick Firestone. The NSD has a home page on the WWW (http://user88.lbl.gov/nsd_home.html) as do many of our research groups. Or you can access us through the Berkeley Lab home page (http://www.lbl.gov) – please visit us!